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TECHNICAL MEMORANDUM (NASA) 24

IMPROVEMENTS FOR OMEGA RF PREAMPLIFIERS

An Omega preamplifier with no phase shift over the ADF band but with bandpass filtering and gain at the Omega-VLF band has been designed, built, and tested. This is expected to be useful principally in planned work at MIT and Princeton involving the use of the Ohio University Omega Sensor Processor Receiver.

by

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## I. INTRODUCTION

An improved Omega navigation system preamplifier, which provides both ADF and Omega outputs from a single antenna input, has been designed and is presently being used by the Ohio University Avionics Engineering Center. This preamp has tuneable bandpass filtering, zero phase shift at both output ports, adjustable gain at the Omega output, and it receives power via the coaxial cable to the receiver front-end.

## II. THE CIRCUIT

As shown in Figure 1, the input stage of the preamplifier is a 2N3819 JFET used as a source follower which has an input impedance of one megaohm. The 100 ohm series input resistor is used as a current limiter for protection against short-duration, high-level interference. This relatively rugged FET in conjunction with the series input resistor should be able to withstand very close lightning discharges; however, this input resistor should be kept small to minimize phase shift at the ADF output.

The ADF output stage is an emitter follower, direct coupled from the output of the JFET. This configuration yields negative gain (-6 dB overall) but does act as a buffer supplying a low impedance output and a signal that is in phase with the incoming signal.

Amplification of the Omega signal is done by the 2N5139, and gain adjustment is accomplished by changing the emitter resistor,  $R_2$ . It was noted that the beta ( $\beta$ ) of the 2N5139's varied considerably from transistor to transistor, which caused significant variations in maximum attainable gain. If a gain of 20 dB is desired, a transistor with a higher beta (150-200) should be used.

Power to the preamplifier and Omega signal to the receiver are carried on the same coaxial cable and isolation in the preamp is accomplished with a small audio transformer. The supply voltage can be anywhere from five to nine volts DC, but must be resistively coupled to the transmission line by  $R_3$ , a 620 ohm resistor.

The amplified Omega signal is filtered by a tuned LC circuit. The approximate component values are shown in Figure 2, with resonance at 10.2 KHz (or 11.33 or 13.6 KHz) obtained by adjustment of the 10 mh coil. The isolation transformer serves the circuit as an additional inductance, while tapping the 2N5139 in the center of the transformer reduces the effective impedance of its collector, as seen by the tuned circuit. This yields a filter with a Q of about 3 which provides excellent bandpass characteristics for the first stage filtering in Omega signal processing.

## III. UTILIZATION

The Omega output of this preamplifier has been successfully flight-tested and two of these units are presently being used, by the Avionics Engineering Center, to supply Omega signals for laboratory use. Both are mounted atop a three story building; one is connected to a short wire and the other to a whip antenna. A third unit



has been constructed for use in antenna tests to be conducted for NASA by Avionics Engineering. At this time, both ADF and Omega outputs will undergo flight evaluations. Also, this preamplifier will probably be the one supplied with the Ohio University prototype receivers under Contract NAS1-14124.

#### IV. ACKNOWLEDGEMENTS

The support of the NASA Langley Research Center, Grant NGR-36-009-017, is acknowledged. The circuit was designed by R. W. Burhans with the fabrication, testing, and evaluation done by the author.



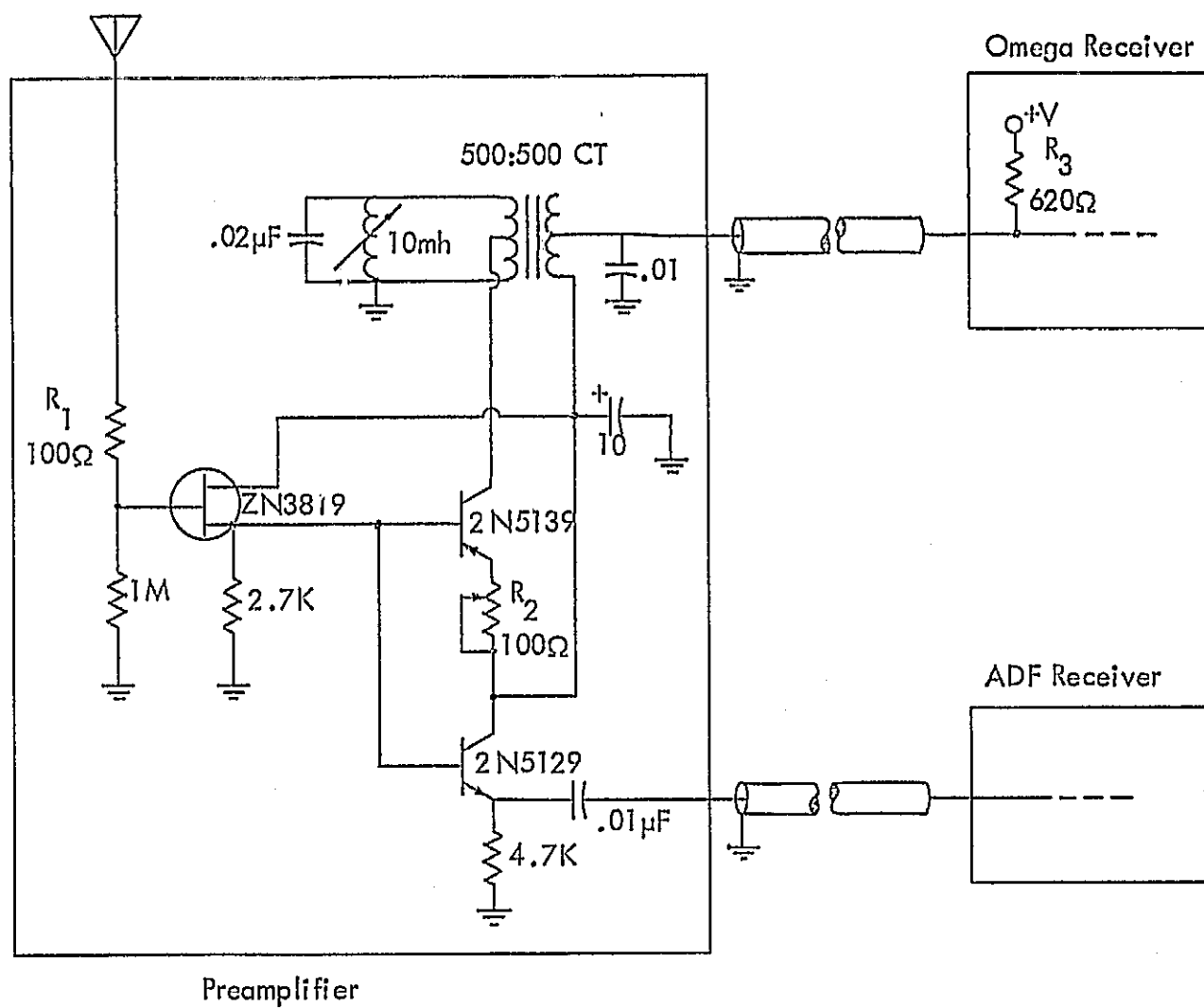


Figure 1. Dual Purpose Preamplifier with Tuneable Filter.



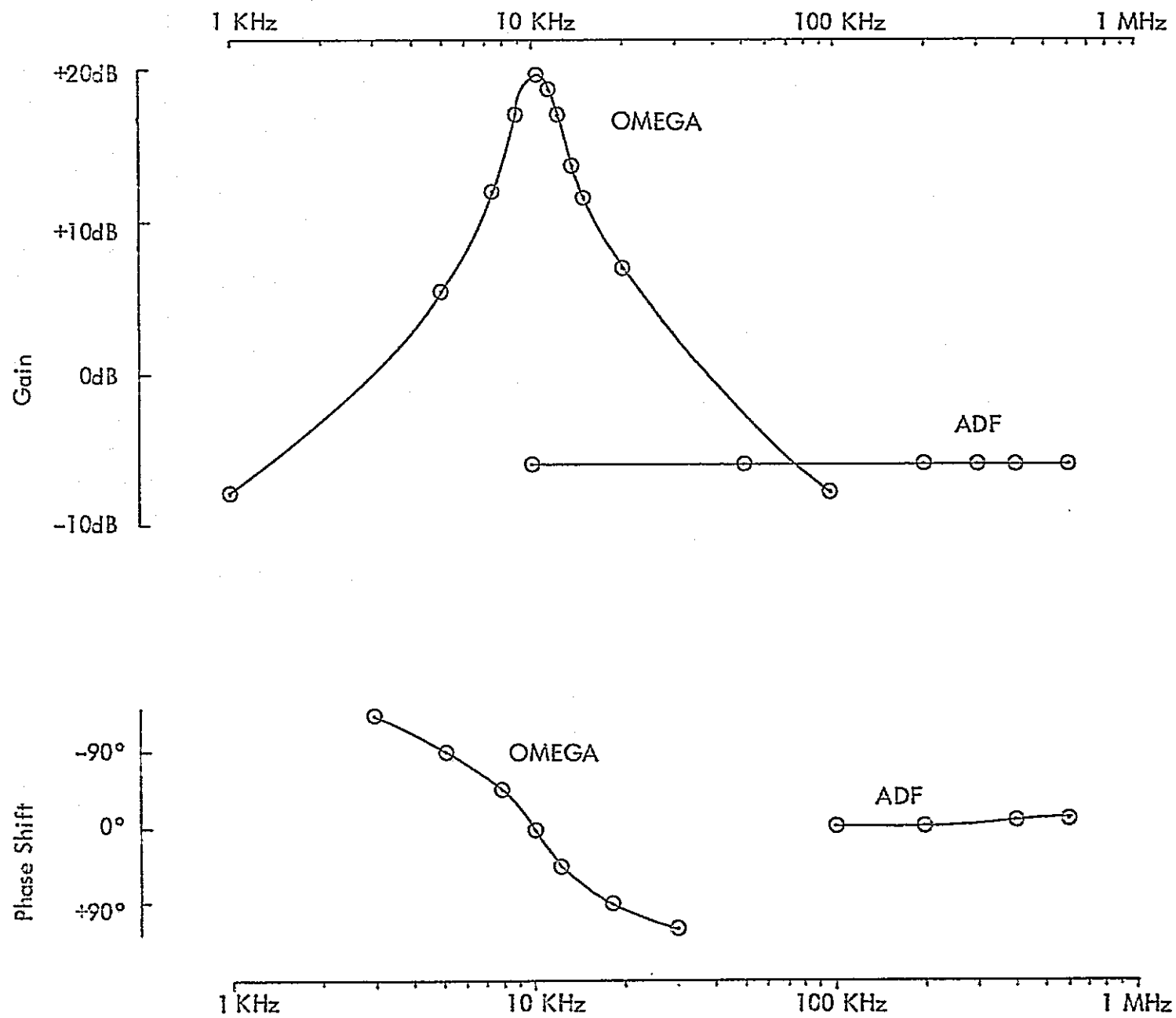


Figure 2. Preamplifier Characteristics.